Chapter 3
RESOURCE FUNCTIONS AND CONSIDERATIONS

INTRODUCTION

Once the water resource functions to be protected by a specific minimum flow or level have been defined, the baseline resource conditions for assessing significant harm must be identified. Considerations for making this determination are set forth in Section 373.0421(1)(a), F.S., which requires the water management districts to consider changes and structural alterations that have occurred to a water resource when setting a minimum flow or level.

This chapter identifies the water resource functions of the St. Lucie River and Estuary; summarizes alterations to the resource; and establishes baseline considerations for MFL development. A detailed accounting of structural alterations and operational protocols is presented in **Chapter 2**.

WATER RESOURCE FUNCTIONS AND CONSIDERATIONS

Watershed

The primary resource functions provided by the St. Lucie River watershed that need to be considered in the development of MFLs include water supply, flood control, maintenance and improvement of water quality, the protection of fish and wildlife habitat, and recreation.

Water Supply and Flood Control

The C-23, C-24, and C-25 Canals and control structures were improved under the C&SF Project. Their current functions are 1) to remove excess water from their respective basins; 2) to supply water during periods of low rainfall; and 3) to maintain ground water table elevations at the coastal structures to prevent saltwater intrusion.

The establishment of MFL criteria for the St. Lucie River will aide in resisting saltwater intrusion into the freshwater ground water table along this coast. Increasing risk of saltwater intrusion into coastal wells is an issue in other areas on the southeastern coast of Florida. This problem will only increase through time as development increases, urban water demands increase, and sea levels continue to rise. MFLs for the St. Lucie River will provide a mechanism for protection of the coastal aquifer.

The C&SF Project canal and control structures in the C-44 Basin have five functions: 1) to provide drainage and flood protection for the C-44 Basin; 2) to accept

runoff from the S-153 Basin and discharge this runoff to tidewater; 3) to discharge water from Lake Okeechobee to tidewater when the lake is over schedule; 4) to supply water to the C-44 Basin during periods of low natural flow; and 5) to provide a navigable waterway from Lake Okeechobee to the Intracoastal Waterway.

Wetland communities in the St. Lucie watershed offer storage, retention, and infiltration sites for surface water flows. Both surface water and ground water sources are used within this watershed to meet potable (urban) water supply needs, and for irrigation of landscape and agricultural crops.

As agricultural and urban development continues, the volume, duration, and frequency of floodwaters may increase. The existing infrastructure of drainage systems was never intended to totally eliminate flooding in developed areas. Natural and undeveloped area in the watershed, as well as the river itself, provide flood control by providing areas for storage and infiltration of runoff as well as a vehicle for moving floodwaters away from developed areas.

Water Quality

Undeveloped lands along the North and South Forks of the St. Lucie River provide an important source of clean fresh water to the estuary. These lands contribute to improved water quality downstream by providing soil stabilization, low pollution loading, reduction of pollutants from runoff, a buffer from urban land uses, maintenance of the oligohaline zone of the river, and reduced risk of hypersalinity to the estuary. Agricultural and urban lands provide sources of excess nutrients, pollutants, and conatminants that may adversely impact estuarine resources.

Protection of Fish and Wildlife Habitat

Maintenance of sufficient water depth within the watershed is needed to protect plant and animal communities in wetlands and lakes. Freshwater lakes and wetlands in the watershed provide habitat for wildlife species that is important to both recreational fishing and hunting interests, as well as for predatory animals (e.g., wading birds). Freshwater fish species include largemouth bass, speckled perch, bluegill, shellcracker, redbreast, warmouth, bowfin, channel catfish, and many species of minnows. Game wildlife include deer, wild turkey, hogs, and ducks. The freshwater swamp community contains a number of species of trees and shrubs that provide important specialized habitats and food (e.g., fruits and seeds) to birds, especially migratory and endangered species, and other wildlife. According to Florida Fish and Wildlife Conservation Commission's *Closing the Gaps in Florida's Wildlife Habitat Conservation System* (Cox et al., 1994), the region was identified as an important area in terms of maintaining several wide ranging species that make up an important component of wildlife diversity in the state. Furthermore, the southeastern Florida region is a unique place for the concentration of migratory species. Many birds use the area for wintering, breeding, feeding, and nesting. In addition, several species of marine fish depend on the fresher water estuary as a spawning and nursery area.

River headwaters originating in this watershed flow to protected lands and water bodies. These include the North Fork St. Lucie River Aquatic Preserve, the North Fork St. Lucie River State Buffer Preserve, and the Indian River Aquatic Preserve. These preserves harbor several protected species (e.g., Johnson's sea grass) that rely on appropriate timing and distribution of freshwater inputs to preserve their habitats.

Recreation

Recreational activities that occur in the watershed include hiking, canoeing, camping, birding, fishing, and hunting. Identifying the MFLs required in the river watershed is necessary to provide for adequate access and enjoyable use of the resource. MFLs are also necessary to sustain the vegetation communities that provide the landscape and wildlife that support these recreational activities.

River

The primary resource functions provided by the North and South Fork riverine communities on the St. Lucie River include water storage, maintenance and improvement of water quality, the protection of fish and wildlife habitat, recreation, and cultural values.

Water Storage

Riverine wetland communities offer storage, retention, and infiltration sites for surface water flows.

Water Quality

The North and South Forks of the St. Lucie River provide an important source of clean fresh water to the estuary. The undeveloped lands and riverine wetlands along the North and South Forks provide water that has little, if any, human-contributed sources of pollution. Riverine wetlands provide significant water quality improvements by stabilizing sediments and reducing suspended solids and nutrients, all of which can have negative impacts to the estuarine communities downstream. The proposed MFL criteria protect this community by providing sufficient fresh water needed to sustain it.

Protection of Fish and Wildlife Habitat

Maintenance of sufficient freshwater flows is needed to protect plant and animal communities in the river system. Oligohaline areas provide habitat for freshwater riverine species of fish that are important to both recreational interests and piscivores (e.g., wading birds). Species include largemouth bass, speckled perch, bluegill, shellcracker, redbreast, warmouth, bowfin, channel catfish, and many species of minnows. The riverine wetland community contains a number of species that provide spawning habitats important to these wildlife species.

Recreation

Recreational activities that occur on or along the river include boating, hiking, canoeing, camping, birding, and fishing. Maintenance of minimum levels is required in the river corridor to provide for adequate access (navigation) and enjoyable use of the resource. MFLs are also necessary to sustain the vegetation communities that provide the landscape and wildlife that support these recreational activities. Impacts on recreational uses may occur in the river due to low water levels that impair the ability to move boats downstream.

In addition to concerns about the impact of low water levels on navigation, excessive freshwater flows can cause shoaling in the estuary. This shoaling can impact navigation and biological communities.

Cultural Values

The upper segment of the St. Lucie River is noted for its cultural significance. The river is used extensively by local residents for recreation, as an employment base (e.g., fishing guides), and enjoyment. It plays a key role in the heritage and daily life of those whose families have lived in the area for generations. Establishment of MFLs for the river will, in conjunction with other preservation efforts, aide in maintaining the river's natural values for future generations.

Estuary

The primary resource functions provided by the St. Lucie Estuary include water supply, maintenance and improvement of water quality, the protection of fish and wildlife, and recreation.

Water Supply

Brackish estuarine communities in general require significant amounts of fresh water in order for desirable salinity concentrations to be sustained. The sources of this water can be from runoff, direct rainfall, seepage, or other means, but the majority of it originates from the river. The development of MFLs for the river must also consider the needs of the estuary in order to assure its health.

Typically, the St. Lucie Estuary has suffered from too much fresh water. Although the current effort to establish MFLs for the river will not address the issue of too much fresh water, they will set a minimum flow that will have more importance as freshwater resources in the region become increasingly divided among other uses in the future. Setting the MFL criteria while abundant freshwater sources are still available to the area will help ensure that amount required to sustain the river's resources can be adequately quantified and secured.

Water Quality

Nutrients

Freshwater inflow to the St. Lucie Estuary may provide an important source of inorganic nutrients that support the primary productivity of this system. While excess nutrients may be a concern in terms of eutrophication and potential for hypoxic or anoxic environments associated with organic loading, the St. Lucie Estuary also depends on a minimum input of new nutrients to this system to maintain productivity (Nixon, 1981). It seems unlikely that short-term limitation of new nutrients to the St. Lucie Estuary would lead to a reduction in productivity that would be harmful to the system, but the role of this input of new nutrients should be considered in determining MFLs.

The timing of freshwater inflows can also impact the nature of the phytoplankton community in an estuary. Experimental and theoretical evidence indicates that a pulsed freshwater release will ultimately result in greater production of fish and larger consumers compared to when water is allowed to "trickle" into the system. Larger planktonic primary producers are able to sequester a greater proportion of growth-limiting nutrients when they are presented at elevated concentrations over a short time interval (Suttle et al., 1988). Therefore, a pulsed nutrient supply will select for larger phytoplankton (Turpin and Harrison, 1980; Suttle et al., 1987). This results in a food web based on large-size phytoplankton, which is more efficient in transferring nutrients and energy to higher trophic levels than is a food web based on pico- or nanoplankton (Suttle et al., 1990).

Dissolved and Particulate Organic Carbon

Input of dissolved and particulate organic carbon to estuaries can come from terrestrial or riverine sources, as well as from primary and secondary production within the estuary. Terrestrial inputs of dissolved and particulate organic carbon to the St. Lucie Estuary will be impacted by minimum flow requirements. At this point, no information is available as to the relative importance of this imported carbon to the productivity of the St. Lucie Estuary, but it should also be considered when setting minimum flows. Relative importance of phytoplankton, sea grasses, and terrestrial carbon can be estimated by examining the stable carbon isotope ratios of particulate organic carbon and various marine organisms (e.g., Fry and Sherr, 1984). Reduced import of organic matter could also in turn affect rates of benthic nutrient flux and biological oxygen demand of sediments.

Inorganic Particles and Sediment Quality

Another factor to consider may be the impact of reduced flow on accumulation of low quality muck sediments. By reducing imported organic matter and nutrients, organic loading of muck type sediments in the St. Lucie Estuary may be reduced, and frequency of hypoxic and anoxic events might be reduced. Alternately, reduced flow might also encourage the accumulation of muck sediments in areas where they would otherwise be scoured and carried down stream during periods of higher flow.

Protection of Fish and Wildlife Habitat

Submerged aquatic vegetation, macro invertebrates, and shellfish form prominent components of the St. Lucie River and Indian River Lagoon ecosystems. Sea grass meadows provide habitat for many benthic and pelagic organisms, such as invertebrates and fishes (Thayer et al., 1984), increase benthic primary productivity, and stabilize sediments (Stoner, 1983; Virnstein et al., 1983; Gilmore, 1987; Fonseca and Fisher, 1986; Woodward-Clyde, 1998). Sea grass meadows also provide food sources for trophically and commercially important organisms (Dawes et al., 1995; Virnstein and Cairns, 1986) and can form the basis of detrital food chains (Zieman and Zieman, 1989). In the Indian River Lagoon, sea grasses provide the ecological basis for a fishery industry worth about a billion dollars a year (Virnstein and Morris, 1996). Sea grasses, including the federally-listed Johnson's sea grass (*Halophila johnsonii),* and oysters are sensitive to changes in water quality (Kemp et al., 1983; Twilley et al., 1985) and are often included in monitoring programs as indicators of estuarine health (Tomasko et al., 1996). Restoration and protection of sea grass and oyster beds are major goals of the *Indian River Lagoon Surface Water Improvement and Management (SWIM) Plan* (Steward et al., 1994).

Recreation

Recreational activities that occur in the estuary include boating, birding, and fishing. Maintenance of MFLs is required to sustain the aquatic communities that provide the landscape and wildlife that support these recreational activities.

ALTERATIONS

Hydrologic Changes

During the past century, many changes have occurred to the hydrology of South Florida driven by the need to improve human agricultural and urban development, and commercial and recreational use. Changes made to provide drainage and flood protection for cities, homes, and farms; to provide water for irrigation; and to improve boat access for recreational and commercial use have irreversibly altered the structure and biological resources of the St. Lucie River and Estuary. These changes include the following:

- Dredging and filling of tidal and freshwater wetlands throughout the watershed have resulted in the destruction of these critical areas for production of fish and wildlife, and have reduced the capacity to store excess fresh water that falls during the rainy season for subsequent slow release to the estuary during dry periods.
- Loss of shoreline habitat due to dredging and filling of coastal waters has resulted in a dramatic decline in tidal marshes and swamps that provide a natural filter to remove sediments, nutrients, and pollutants from the water column.

- Channelization of tributary rivers and streams has resulted in the major restructuring of the volume, timing, and distribution of freshwater flows to the estuary.
- Construction of the St. Lucie Canal that connects the estuary to Lake Okeechobee has resulted in a major new source of freshwater discharge that did not occur historically.
- Stabilization of the St. Lucie Inlet has resulted in increased rate and volume of freshwater exchange with the ocean. This tidal exchange transformed what was historically a freshwater river into a riverine estuary.
- Dredging of the Intracoastal Waterway and navigational channels, including the removal of sand and oyster bars that typically inhibit the rate at which freshwater discharges from the river to the sea, have increased the rate of both freshwater and saltwater exchange with the Indian River Lagoon and the Atlantic Ocean.

Water Quality and Biological Changes

Prior to the opening of the St. Lucie Inlet, historical evidence indicates that the system was dominated by freshwater conditions. Natural channels were deep. This suggests that large amounts of fresh water entered the system from a productive watershed, but that sediment loads were low, perhaps the result of a pristine and flat terrain. Submerged aquatic vegetation was abundant, but oysters may have been rare. Fish and wildlife were also abundant.

Hydrologic changes during the past century have altered water quality and biological conditions in the estuary. The estuary has experienced increased loadings of sediments, nutrients, and pollutants; highly varying salinities; increased duration, frequency, and extent of hypoxia and anoxia; and low transparency due to high color. The combination of physical, hydrologic, and water quality changes has resulted in large-scale loss or destruction of habitats, especially tidal marshes, swamps, grass beds, and other benthic communities that naturally form the productivity basis of the food chain for estuarine and coastal ecosystems. Plant and animal communities in this ecosystem have been impacted by habitat alteration and destruction, resulting in increased duration and frequency of phytoplankton blooms, loss of submerged aquatic vegetation, probable expansion and then extirpation of oyster reefs, decline in abundance and catches of commercial and sport fisheries and overall decline in diversity and abundance of wildlife resources.

SUMMARY AND CONCLUSIONS

Based on evaluation of the functions and considerations of the St. Lucie River and Estuary watershed, it was determined that these systems are highly modified from their historical conditions. Without protection of natural resources in the St. Lucie River and Estuary watershed, water quality will become degraded, impacting riverine and estuarine communities downstream. Determination of the lower limit of flows that constitute significant harm to this riverine system, and to the estuary by downstream association, will be linked to the maintenance of salinity levels. Salinity is a major ecological variable that controls important aspects of estuarine community structure and food web (Myers and Ewel, 1990).

EXCLUSIONS

Section 373.0421(1)(b), F.S., provides exclusions from the MFL requirement by recognition that certain water bodies no longer serve their historical function and that recovery of these water bodies to historical conditions may not be feasible. District staff determined it was not appropriate to apply the exclusion in Section 373.0421(1)(b)1, regarding historic functions, to the establishment of minimum levels for St. Lucie River system. This area has been greatly altered by development and associated needs for water supply and flood protection to the extent that full recovery of water levels and flows in the river headwaters, the river itself, and the estuary may be technically and economically infeasible. However, the need to protect and enhance the remaining natural features in this system has been clearly identified. The considerations in Section 373.0421(1)(a), F.S., seem to adequately address the changes and alterations in water resource functions applicable to these areas. As a result, no apparent basis exists to invoke the exclusion in Section 373.0421(1)(b)1, F.S., or to document the economic and technical feasibility of recovery.

The remaining exclusions in subsections 373.0421(1)(b)2 through 3, F.S., pertain to water bodies less than 25 acres in size or constructed water bodies and, as such, are not applicable to the St. Lucie River and Estuary.